THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VIII.—No. 187.

FAST SPEED WORKING ON CABLES.

PERHAPS at the present time no field of invention offers to electricians so rich a prize as that of submarine telegraphy. It is well known that the duration of a cable in good working condition is comparatively brief. It follows, therefore, as a matter of necessity that the profit on the large capital outlay, entailed in laying a cable, and the requisite reserve fund, be secured during a short period varying from ten to possibly twenty years. Now the carrying power of a submarine line being limited (although, thanks to the ingenuity of Mr. Stearns and the Messrs. Muirhead, less so than formerly), it follows that while the above conditions last, the tariffs must remain quite up to the existing rates if they are to be at all profitable.

It is, however, a matter well worth consideration whether the carrying power of cables cannot be increased by the employment of a quadruplex or multiplex system, or by the employment of automatic fast speed apparatus. The latter seems the more likely field for successful invention, and although we believe something has been attempted in this direction, no success has been attained as yet. The idea of the new American Cable Company recently organised in New York, to submerge a translator or repeater in mid ocean, is undoubtedly a correct one, but the practical feasibility of the project is more than open to question. It is hardly too much to say that no piece of mechanism has ever yet been devised which can be trusted to work with certainty to an indefinite period without human supervision. As is well known, the cause of the retardation of signals in submarine cables is the inductive effect, which causes the cable to hold a charge which has to be got rid of after each signal has been sent and before another can be transmitted. Could some arrangement be devised by which this charge can be "wiped out" at *both* ends of the cable simultaneously, a great advance would be made towards solving the problem of fast speed submarine telegraphy. It seems to us that there is considerable scope for invention in this direction.

All inventions for working through long ocean cables must necessarily be unsatisfactory unless submitted to actual test; but the latter to the very great majority of inventors is an impossibility, as they cannot have access to any cable on which to make their experiments. Seeing the importance of the subject, we would suggest that amongst the apparatus provided for the proposed public electrical laboratory in connection with the Society of Telegraph Engineers, an artificial cable might with great advantage be included.

One thing is at least certain—that the fortunate inventor who can effect a notable improvement in the direction of fast speed submarine telegraphy will be in the enviable position of being able practically to demand his own terms. Take, for instance, the case of a company with a given number of cables, the traffic continuous, and the tariff adjusted so as to be sufficiently profitable. Continue the supposition, and imagine another company laying a single line of a precisely similar type of cable, but the carrying power of which was by any means considerably increased. The traffic over this cable could be conducted at a proportionately less rate than over any one of the others, with as good, perhaps a better, remuneration than it could be by the company owning the larger number of cables, but which worked at the slower speed.

The inventor who can materially increase the rate of working on submarine lines will be able, as we before stated, to demand his own reward; the then existing companies must either buy or run the risk of what would be an overwhelming competition. The field is open to all: a fortune will probably be the reward of him who tries to solve the problem, and—succeeds.

M. FLOYER, the Superintendent of the Egyptian Government Telegraphs, writes that he tried the Gower-Bell Loud-Speaking Telephone on the ordinary telegraph lines between Cairo and Alexandria, looping two lines together to get a total length of 260 miles, and that the talking was very successful, notwithstanding that Morse instruments were working on the adjoining ten lines.

IN connection with the subject of telephonic communication, we may mention that one of our largest railway companies, which twelve months ago considered the desirability of using telephones and then abandoned the idea, are now, after having tried the Gower improved instrument, anxious to have them applied generally on their system.

A NEW RELAY.

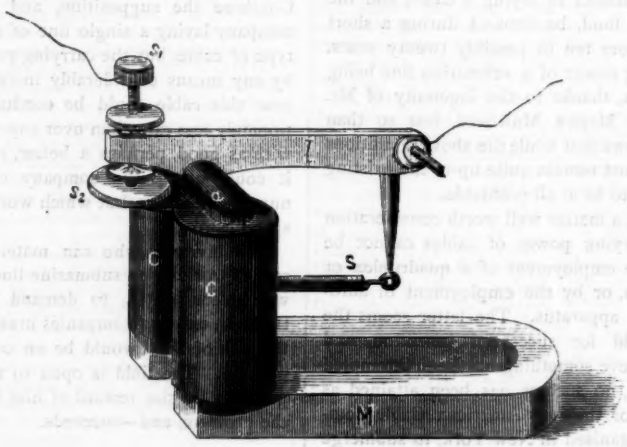
THE relay, a drawing of which is given below, is the invention of Mr. C. C. Vyle of the Postal Telegraph Department, London, and is really an adaptation of the principle used by Professor Hughes in the electro-magnet of his type-printer, though we believe the inventor was not aware of this fact for some time after his idea had taken practical shape.

In its appearance and build it is certainly not suggestive of the great delicacy which it undoubtedly possesses, as proved by exhaustive comparative trials with Post-office Standard Relays, and in actual working upon some of the longest and busiest circuits in the United Kingdom.

With slight alterations in the adjustments it is also claimed to work well as a direct double current sounder, and satisfactorily so in all weathers.

The general construction is as follows :—

An ordinary horse-shoe magnet, M, is laid horizontally beneath the base of the instrument, each leg of



the magnet being fitted with a cylindrical soft iron continuation which rises perpendicularly through the base and goes to form the cores of the electro-magnet, C, C. The coils of the electro-magnet are wound differentially to 200 ohms each, and may therefore be worked singly or duplex. At one end of the lever, *l* (which works in jewelled bearings), and immediately over the cores, is fixed a soft iron armature, *a*, which is attracted by the induced magnetism of the cores.

Towards the opposite end of the lever is attached a spiral spring, S, and adjusting screw, by means of which the force of the magnetised cores over the soft iron armature may be varied or counteracted as circumstances require. Still nearer this end of the lever are the limiting stops, S_1, S_2, insulated in the usual way.

The most delicate adjustment of the relay is said to be arrived at when the tension spring just balances the attraction of the cores and the lever lies indifferently in either position, and when the limiting stops are just sufficiently apart to break contact and prevent ill effects from the spark from the local battery.

For sounding purposes, the stops of course require opening out considerably.

From the foregoing it will readily be understood that if a current be sent through the coils tending to strengthen the polarity already induced in the cores by the permanent magnet, the soft iron armature will be drawn to or retained upon the cores against the tension of the spring ; if, however, the current should be in such a direction as to tend to neutralise the existing polarity, then the attractive power will be lessened and the spring will do its work by drawing up the lever to the top stop.

The relay, when well made and well adjusted, will give good signals with one Daniell cell working through a resistance of 10,000 ohms, and if the latter be all removed the relay will still respond properly without requiring to be re-adjusted ; this is a great point.

Although Mr. Vyle may not have discovered any new principle in his relay, yet he has certainly shown that there are still some old ones to be worked out.

NEW ELECTRIC LAMPS.

SWAN'S INCANDESCENT LAMP.

AT a recent meeting of the Literary and Philosophical Society of Newcastle-on-Tyne, Mr. J. W. Swan brought forward and exhibited his new incandescent electric lamp, which is undoubtedly the most perfect of the kind yet devised. The original form of the lamp devised twenty years ago by Mr. Swan is shown by fig. 1, which represents the front elevation of the lamp. For various reasons this lamp did not prove a success, the principal cause of failure being that which has been observed in other lamps of the kind, viz., the con-

tinual volatilisation of the carbon, which caused a smoky deposit to be deposited on the sides of the glass globe in which the incandescent carbon was set. This volatilisation, Mr. Swan has discovered, may, to a great extent, be prevented by making the vacuum in the glass a very perfect one, the carbon being heated to a high degree of incandescence whilst the exhaustion is progressing. A special method of preparing the carbon has also been discovered by Mr. Swan, so that the material can be formed into very thin strips as hard and elastic as a bit of steel, and unalterable by the action of the current as far as has been seen at present.

The new form of lamp is shown by fig. 2, and is self-explanatory.

As regards economy, Mr. Swan stated that more illuminating power was indirectly obtained from gas burnt in the engine than was obtained from the much larger quantity of gas consumed at the burners.

SCRIBNER'S ARC LAMP.

This lamp is the invention of Mr. C. E. Scribner of Chicago, and in general principle is similar to the "Brush" lamp, though it differs from the latter in several particulars.

Fig. 3 is a front view, and fig. 4 is a side view of the lamp.

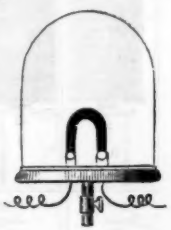


FIG. 1.

C is an electro-magnet of small resistance placed in the circuit of the carbon points, E, E^1, and of the generator of electricity.

The poles of the magnet, C, C, are faced with copper or other non-magnetic metal, so that the iron armature, N, cannot come into contact with them; *h*, *h*, are two brass screws fixed into the poles of the electro-magnet, and passing through holes in the armature. E, E^1, are the carbons; they are held in the metal supports *p*, p^1; W, V, and T, are binding screws to receive the connecting wires.

There is a hole in the armature, N, through which a rod, F, passes, and the hole fits the rod so closely that when the armature is slightly inclined the rod becomes nipped in the hole, but otherwise the hole is just large enough for the rod to move freely through it.

To the armature, N, two springs, M, are attached, one on each side of the rod, F. These springs are sufficiently strong to sustain the rod, F, in the position it occupies against the force of gravity acting on the rod, its carbon, and carbon carrier; K, L, are two springs of unequal tension acting on the armature, N. *l*, *m*, are regulating screws screwed into the frame as shown, and serving to regulate the tension of the springs, K, L.

D is an electro-magnet of high resistance placed in a shunt circuit shunting the voltaic arc; its poles are tipped with brass or other non-metallic metal to prevent the armature coming into actual contact with the poles of the magnet; *g*, *g* (fig. 3), are two brass screws screwed into the poles of the electro-magnet, D, and passing freely through holes in the armature, H. There is also another hole in the armature, H, through which the rod, F, passes.

The rod, F, fits the hole in the armature, H, so nearly, that when the armature assumes a slightly inclined position in relation to the rod, it locks itself fast upon the rod; nevertheless the hole is sufficiently large to allow the armature to move independently of the rod when it is at right angles to it; I, J (fig. 3), are two springs of unequal tension acting on the armature, H; *f*, *f*, are two regulating screws screwed into the frame, and serving to regulate the tension of the springs, I, J; *a* is a tongue (fig. 4) projecting from the armature, H; G is a metal support.

O is a piece of vulcanite or other non-conducting matter attached to the support, G, by the screw, *o*;

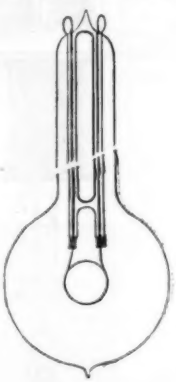


FIG. 2.

p is a piece of metal mounted in a guide-groove on G, in such manner that it can move vertically; *i* is a screw passing through the spring, *r*, and also through a slot in *p*; it is screwed into the support, G. The spring, *r*, is held by the head of the screw, *i*, so as to press against *p* with a force sufficient to maintain it in place against the action of gravity; *b*, b^1, are screw stops tipped with vulcanite or otherwise prevented from forming an electrical connection with the armature, H. They are screwed into the piece, *p*; *d* is a flat spring, and *e* is a rigid stop for the spring, *d*; *c* is a platinum-pointed screw screwed into a small boss upon the end of the spring, *d*.

The main current enters by the binding screw, W, the voltaic arc, the rod, F, and by a flexible wire to the binding screw, V, from thence by the coils of the electro-magnet, C, C, to the binding screw, and by a return wire to the generator.

The current in the shunt circuit shunting the voltaic arc passes from the binding screw, W, by the wire of the electro-magnet, D, the screw, *o*, the

frame, *g*, the piece of metal, *p*, the screw, *c*, the spring, *d*, and the wire connection to the binding screw, T.

When there is no current passing through the lamp or regulator, the armature, H, sustained by the springs, I, J, rests against the heads of the screws, *g*, *g* (fig. 3), and the tongue, *a*, pressing on the point of the screw, δ^1 (fig. 4), holds the piece, *p*, in contact with the point of the screw, *c*, and the shunt circuit is thus closed. The armature, N, is also drawn away from the poles of the electro-magnet, C, by the springs, K, L, until the points of the carbons, E, E^1, come into contact.

As soon as the current from the generator passes through the regulator the armature, N, is drawn towards the poles of the electro-magnet, C, C, and in consequence of the unequal tension of the springs, K, L (fig. 4), the armature, N, in approaching the poles of the electro-magnet, assumes a position inclined to the rod, F, and nipping or locking fast with it, carries the rod up, and thus the carbon points are separated and the voltaic arc established.

When the armature, N, comes against the poles of the electro-magnet it takes a position square with the rod, F, and ceases to nip or lock itself with the rod, which is then maintained in position against the force of gravity acting upon it by the friction holding of the springs, M, M.

The electric current divides itself between the main circuit and the shunt circuit, and the relative quantity of current in the two circuits is inversely proportional to their resistance.

As the points of carbon burn away and become more distant the one from the other, the resistance of the voltaic arc gradually increases, and consequently the quantity of electricity passing in the coils of the electro-magnet, D, also gradually increases, and the attraction of the magnet upon the armature, H, becomes stronger.

When the attraction is sufficient to overcome the tension of the springs, I, J, the armature, H, approaches the poles of the electro-magnet, D. In consequence of the unequal tension of the springs, I, J, the armature, H, when attracted towards the poles of the electro-magnet, D, takes a position inclined to the rod, F, locks itself to the rod, and

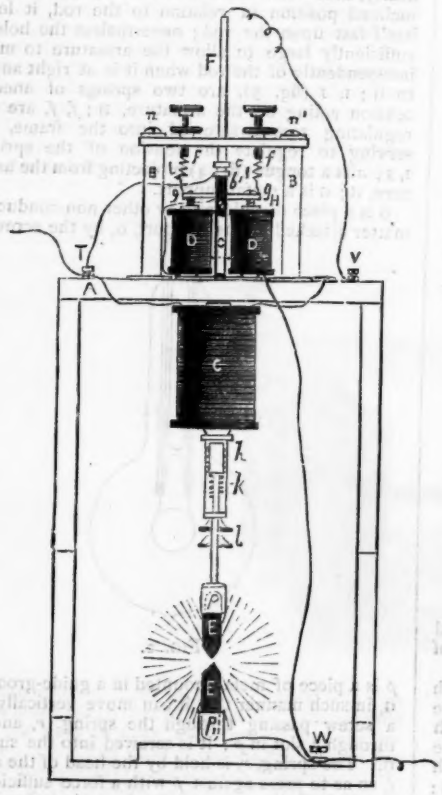


FIG. 3.

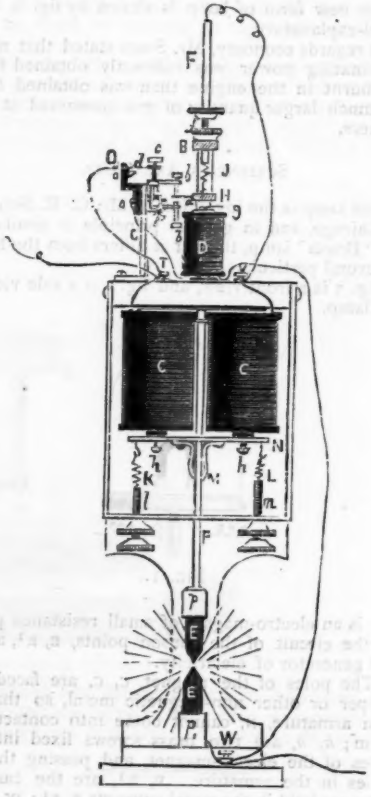


FIG. 4.

as the armature itself descends carries it down in spite of the friction holding of the springs, M, and so the carbon points, E, E^1, are brought nearer together.

When the armature, H, is drawn down as described above, the tongue, *a*, comes to the point of the spring, *b*, and pressing upon it causes the piece, *p*, to move, so as to separate *p* from contact with the point of the screw, *c*. By this means the shunt circuit is broken and the electro-magnet, D, loses its magnetism. The springs, I, J, immediately bring back the armature, H, to a position square with the rod, F. The armature then ceases to nip the rod, which remains in the position to which it was brought during the descent of the armature, being supported in the frictional holding of the springs, M. The armature, H, is then brought back by the springs, I, J, to its first position against the heads of the screws, *g*, *g*. By the same movement the tongue, *a*, is brought up to the screw, *b*, and pressing on its point it raises the piece, *p*, into contact with the point of the screw, *c*, and the shunt circuit is again complete.

The current passing in the shunt circuit has, however, been decreased by the approximation of the carbons brought about during the descent of the armature, H, and so the armature will remain for a certain time against the heads of the screws, *g*, *g*, until by the further consumption of the carbons the resistance of the main circuit again becomes sufficient to divert a sufficient proportion of the current through the shunt circuit to enable the electro-magnet, D, again to draw down its armature.

The length of the voltaic arc can be regulated by varying the tension of the springs, I, J. The length of movement of the armature, H, and consequently the distance of the rod, F, carried down at each movement of the armature, can be regulated by adjusting the screws, *b*, b^1.

SPAGNOLETTI'S ELECTRICAL FIRE ALARM.

THIS invention consists, in the first place, of a train of clock-work to run off a paper ribbon as in a Morse telegraph instrument. This train of clock-work is automatically started into action by the same current that sends the signal from the place the alarm is given; it can also be made to stop automatically, or it can be stopped by the attendant after seeing what station has given an alarm. The instrument has an indicator on it, and shows when it requires winding up. A bell is also attached which is made to ring when winding up is required, so that if this is neglected notice is given of the fact. In addition to this a key for sending a current to any outlying station is attached for acknowledging signal or signals. Bells are added to call attention when an alarm is given; these bells may be tremblers, but each has attached to it an earth connection for the bell hammer to work against, so as to discharge the line wire. By this contrivance any number of bells can be arranged on one wire; without this arrangement this cannot be done. The signal given denoting a station sending an alarm is given by a code of letters or ciphers. These signals are sent in the following way :—

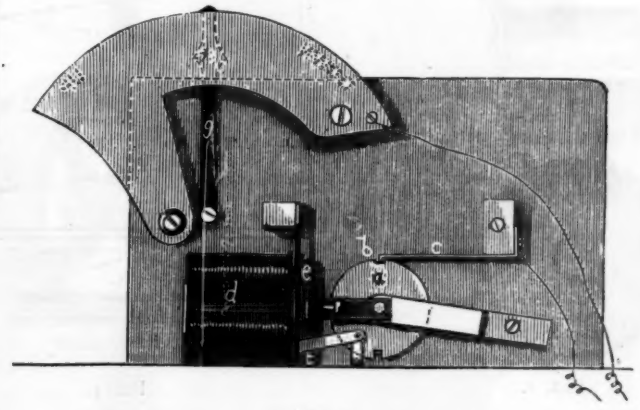


FIG. 1.

Graduating slopes or planes are fixed in a box and are covered or partly covered with metal or wire, so arranged that a metal ball, ring, or wheel will gradually roll down these slightly inclined planes or slopes, and in order to arrest its speed even stages are provided here and there. As the ball, ring, or wheel follows its course and runs over the metal lines it joins one to the other through itself, and thus completes the circuit. The metal being at required intervals insulated (or terminated in certain sections) the ball ceases to make contact when passing over these portions, and thus any signals required can be sent. The ball following

its course can be made to repeat any number of signals or a signal any number of times, or the ball can be made to press down light springs as it travels, the springs making contact as required. On the ball terminating its course it rests on pieces of metal, and connects if required a bell for the acknowledgment signal from the station the signal has been sent to, so that the simple act of dropping this small metal ball into the box starts the instrument at the station, records the letter or cipher of the station sending the signal any number of times required, rings a bell to call attention at the far end signalled to, and finally connects up a bell for the return or acknowledgment signal. One line wire is all that is required, but with two a system can be arranged by which all outlying stations can be

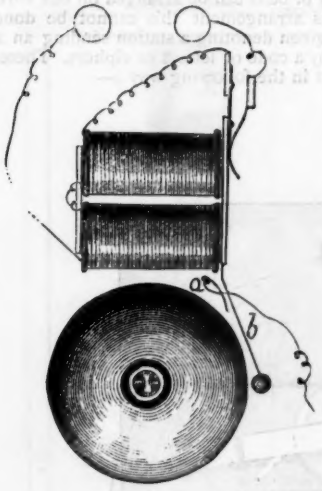


FIG. 2.

signalled to giving notice where a fire is, so that if any station signals to the head office of the district that a fire has broken out, the head office can send to all outlying stations and advise them where the fire is. This is done by audible or other signals. One instrument is sufficient for any number of outlying stations, but by having less stations on one, and using two or more, it may be found more convenient. One battery is required for the instrument, and one may be used for the bells. When the system of sending between all stations is adopted this can be arranged by multiplying the apparatus.

Fig. 1 represents the arrangements adapted to an ordinary Morse instrument; *a* is a wheel on which are formed slots, *b*, into which spring, *c*, takes. This wheel, *a*, is actuated by the ordinary clockwork, and during its revolution the contact of the wheel, *a*, between the slots is maintained with spring, *c*, and the instrument is kept working. *d* are coils which set the instrument in motion by pulling forward the piece, *f*, when armature, *e*, is attracted; *f* is a quadrant, which, with pointer, *g*, shows when the instrument requires winding.

Fig. 2 shows the bell for calling attention when alarm is given. To this bell is applied the spring, *a*, which has an earth connection, so that as the bell is struck the part, *b*, comes against *a*, and the line wire at each stroke is discharged.

Fig. 3 shows the box with graduated slopes or planes; *c* is ball, which on spring, *d*, being raised, rolls down the slopes, space being allowed for the

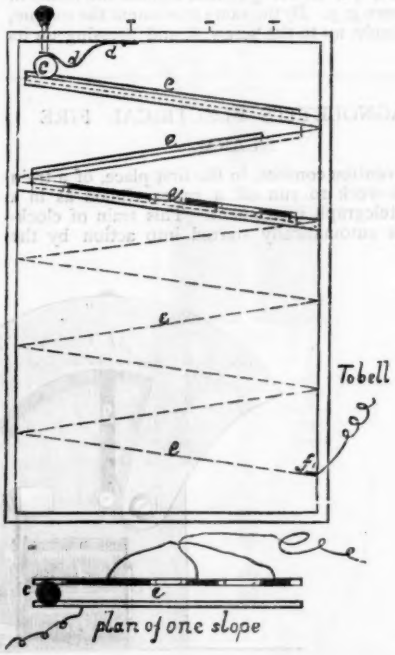


FIG. 3.

ball to fall from one slope to another. In its course by running over the metal lines, *e*, the necessary indications are given. On arriving at f^1, a bell is connected up to receive an acknowledgment signal.

MAXIM'S ELECTRIC-LIGHT CURRENT REGULATOR.

THE current regulator, which is shown in perspective in fig. 1 and side view in fig. 2, controls the current perfectly, and proportionates it so accurately to the work to be done that it makes no difference whether there are 50 lamps in the circu it or only one, the current in the single lamp whe n

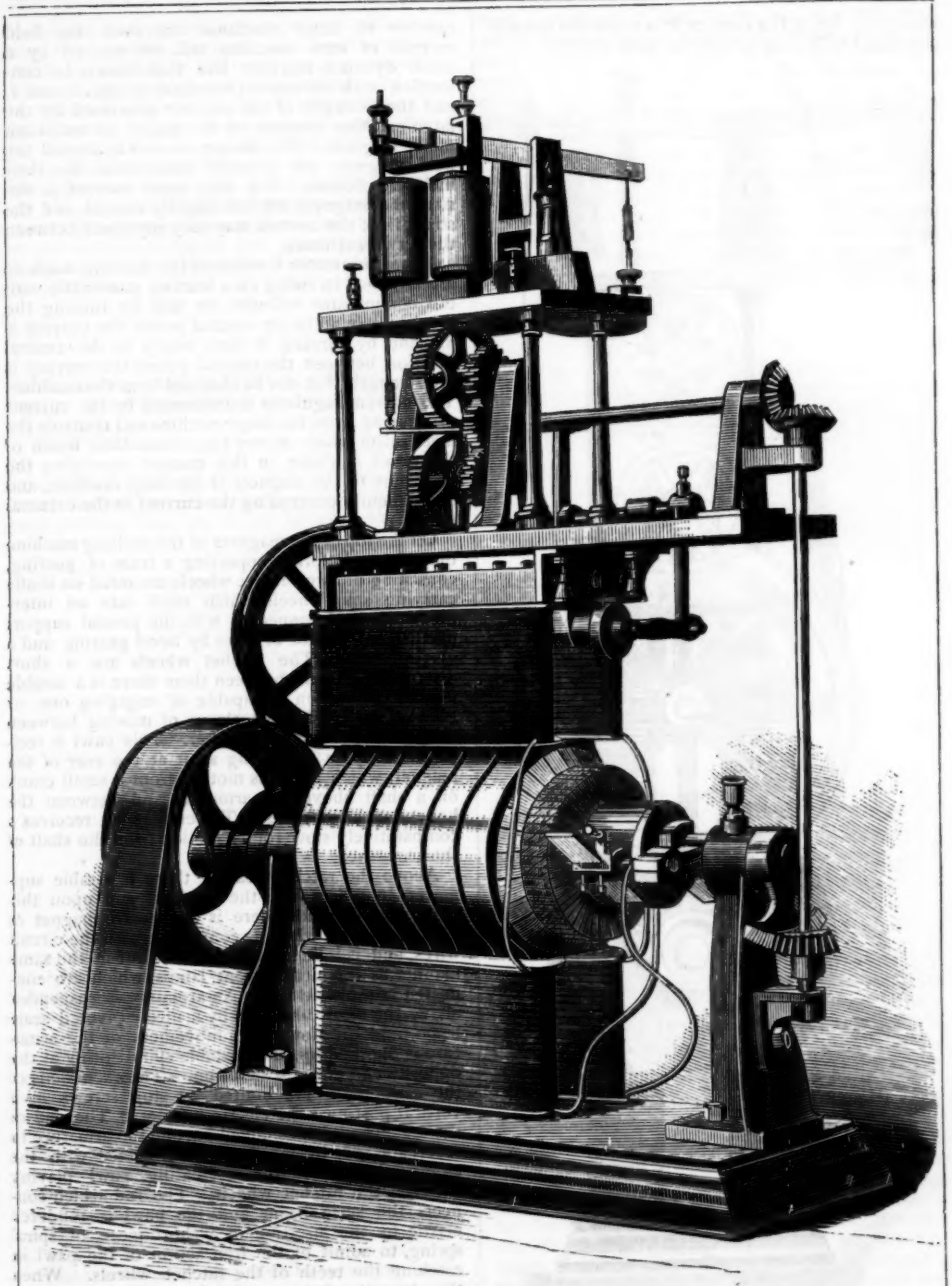


FIG. 1.

used alone, being the same as it is when the lamp is associated with 49 others in the same circuit.

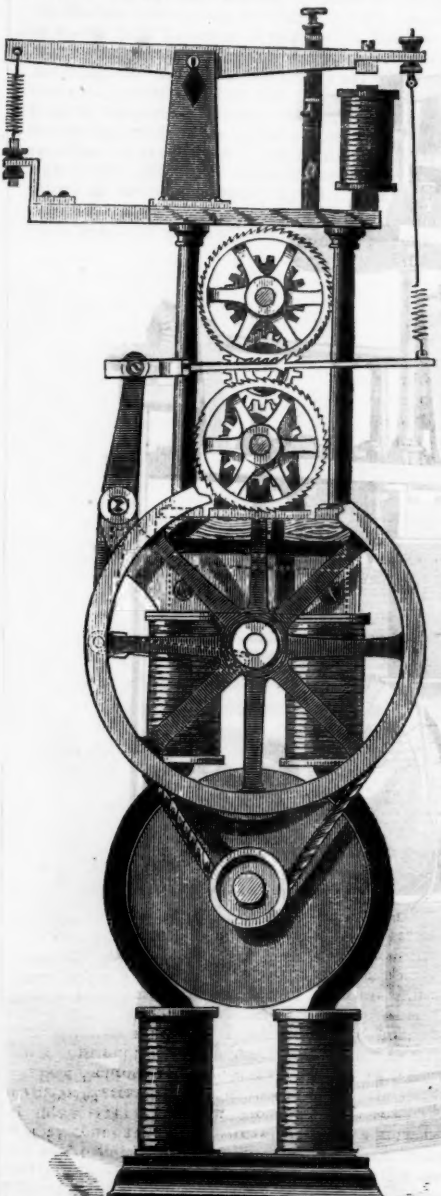


FIG. 2.

The manner in which this result is secured will be apparent on studying figs. 1 and 2. Where a number of large machines are used, the field magnet of each machine will be excited by a small dynamo machine like that shown in connection with the current regulator in figs. 1 and 2, and the strength of the current generated by the large machine depends on the degree of excitation of its magnets. If a strong current is desired the field magnets are strongly magnetised by their inclosing helices. If a very weak current is desired the magnets are but slightly excited, and the strength of the current may vary anywhere between these two extremes.

The commutator brushes of the exciting machine are arranged to swing on a bearing concentric with the commutator cylinder, so that by turning the brushes around to the neutral points the current is nil, and by turning it back nearly to the central position between the neutral points the current is the strongest that can be obtained from the machine. The current regulator is influenced by the current proceeding from the large machine and controls the mechanism which moves the commutator brush of the small machine, in this manner regulating the excitation of the magnets of the large machine, and consequently controlling the current in the external circuit.

On the top of the magnets of the exciting machine there is a platform supporting a train of gearing, consisting of two ratchet wheels mounted on shafts carrying spur wheels which mesh into an intermediate wheel connected with the pivotal support of the commutator brushes by bevel gearing and a vertical shaft. The ratchet wheels are a short distance apart, and between them there is a double faced pawl, which is capable of engaging one or both of the ratchet wheels, or of moving between them without touching either. This pawl is reciprocated by an oscillating shaft at the rear of the magnet, which takes its motion from a small crank on a shaft above the armature and between the helices of the magnets. The crank shaft receives a comparatively slow rotary motion from the shaft of the armature.

Above the ratchet gearing there is a table supported by pillars from the platform, and upon this table near one side there is an electro-magnet of high resistance, which is connected with the circuit wires, and is influenced by the current in the same manner as the incandescent lamps, which are connected in multiple arc. An armature is suspended above the electro-magnet by a nicely pivoted scale beam, and the downward movement of the armature is opposed by an adjustable spiral spring at the opposite end of the scale beam. The excursions of the scale beam are limited by stop screws in a vertical post near the electro-magnet. The end of the scale beam is prolonged beyond the armature to receive a rod, by which it is connected with the elongated end of the oscillating pawl playing between the ratchet wheels. The rod which connects the scale beam and the pawl is rendered elastic by the insertion of a short piece of spiral spring, to admit of the free action of the pawl in catching the teeth of the ratchet wheels. When the strength of the current is augmented by the removal of several lamps from the circuit, the armature of the regulator magnet is drawn down, permitting the pawl to engage with the lower ratchet wheel, which is turned one notch at a time

until the commutator brushes are moved, so as to reduce the exciting current, and consequently diminish the current in the lamp circuit. Should the current diminish beyond the normal strength the armature is released, the spring moves the scale beam, bringing the pawl into engagement with the upper ratchet wheel, when the result will be opposite to that just described.

The incandescent lamps, in connection with which this regulator is more especially intended to be used, are connected in multiple arc; that is, they are connected across two parallel wires, so that the current is divided up between all of the lamps in the same circuit. Now, it is obvious that, when a number of the lamps are removed, the current would, under ordinary circumstances, be much stronger in the lamps that are allowed to remain in the circuit, but when the regulator is applied there is no perceptible difference in the light given out by the lamps, whatever may be the number in circuit.

As many as 64 lamps have been brought up to over 30 candle-power each in a single circuit by one large machine, and the lamps have been removed from the circuit until only one remained and then all replaced, the regulator meanwhile adapting the current perfectly to the widely varying conditions.—*Scientific American.*

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXI.

THE UNIVERSAL BATTERY SYSTEM.

WITHIN the last two years the system of working several circuits from one set of batteries has been revived with great success. This system, which was tried many years ago, appears to have failed on account of the unsuitableness of the batteries employed for the purpose, and also, no doubt, on account of the imperfect state of the insulation of the lines at that period, which rendered heavy battery power necessary for working a single line when the weather was bad and leakage considerable. At the present time, when the lines are kept in a high state of efficiency, the Universal system is entirely successful and economical.

The possibility of the Universal system is dependent upon the fact that when a battery has a low resistance the connection to it of several lines of equal resistance reduces the *total* resistance in the circuit of the battery nearly in direct proportion to the number of lines connected up, and as this reduction of resistance increases the amount of current flowing out of the battery proportionately, the total amount of current when split up amongst each of the lines gives to each a current of nearly the same strength as that which would be obtained on a single line connected to the same battery. If we suppose the current from the battery with one line connected to it to be 1, then 1 will be the current working the line. If now we connect two lines to the battery the resistance in the circuit of the latter becomes halved, consequently the current

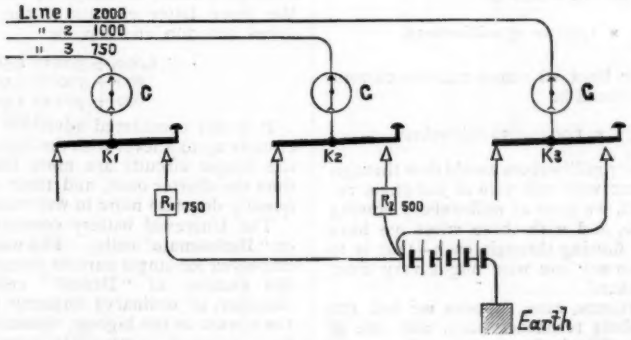


FIG. 79.

flowing out will be 2, and half of this will flow through each line—that is to say, there will be a current equal to 1 flowing through each. Similarly, if we have three lines, the current out of the battery will be trebled, and a third of this, or a current equal to 1, will flow through each line, as at first.

If the resistance of the battery were equal to 0, then no matter how many lines of equal resistance we added on, the current through each would still remain the same. But it is, of course, impossible to get a battery of a resistance equal to 0; as long, however, as the joint resistance of all the lines is not *less* than the resistance of the battery, the current flowing through each line will not be very much less than that which would flow through a single line, supposing the latter were the only one connected to the battery. In fact, so long as the joint resistance of all the lines worked from the battery is not less than the resistance of the battery, then no matter how many lines we connect to the

latter, the current through each of them can never be less than one-half the current which would be obtained through any single line of the set, supposing that line were the only one connected to the battery, and as a rule it would be very much more than one-half. Thus, for example, suppose we grouped two lines, each having a resistance of 200 ohms, on to a 10-cell Daniell battery of 100 ohms resistance, then if one line were connected to the battery the current flowing through the line would be

$$\frac{10}{100 + 200} \times 1{,}000 = 33 \text{ milliwebers},$$

and if the two lines were connected then the current out of the battery would be

$$\frac{10}{100 + \frac{200}{2}} \times 1{,}000 = 50 \text{ milliwebers},$$

and of this $\frac{50}{2}$ or 25 milliwebers would flow through each line. So that with one wire of 200 ohms resistance connected we have 33 milliwebers flowing through that wire, and with two wires we have 25 milliwebers flowing through each wire—that is to say, the current on any one wire might vary from 33 to 25 milliwebers.

If we had three lines of 300 ohms each, then with a single line the current would be

$$\frac{10}{100 + 300} \times 1{,}000 = 25 \text{ milliwebers},$$

and with the three lines all connected the current from the battery would be

$$\frac{10}{100 + \frac{300}{3}} \times 1{,}000 = 50 \text{ milliwebers},$$

and of this $\frac{50}{3}$ or 16·7 milliwebers would flow through each line. So that with one wire of 300 ohms resistance connected, we have 25 milliwebers flowing through that wire, and with three wires we have 16·7 milliwebers flowing through each—that is to say, the current on any one wire might vary from 25 to 16·7 milliwebers.

To take an extreme case, suppose we had 100 wires of 10,000 ohms resistance each, and one of these was connected to the battery, then the current through that wire would be

$$\frac{10}{100 + 10{,}000} \times 1{,}000 = 1 \text{ milliweber},$$

and with all the wires connected we should have a current out of the battery equal to

$$\frac{10}{100 + \frac{10000}{100}} \times 1{,}000 = 50 \text{ milliwebers},$$

and of this $\frac{50}{100}$ or $\frac{1}{2}$ milliweber would flow through each wire—that is to say, on any one wire the current might vary from 1 to $\frac{1}{2}$ a milliweber.

In each of the cases we have taken the joint resistance of all the wires is equal to the resistance of the battery. In the last case we have seen that if all the circuits were working at once the current which would be produced on each would be half that which would be produced on a single wire working by itself. It is, however, highly improbable that every circuit would be transmitting a signal exactly at the same time, consequently the likely variation in the current would in practice be very much less than that indicated.

As a rule it is seldom that more than five or six circuits can be grouped together on one battery, as the combined resistance of a greater number of circuits would, as a rule, be less than the resistance of the number of cells which would be required to work them.

It is not absolutely necessary that the circuits worked from one battery be all of exactly the same resistance, though it is not considered advisable to let the variation be greater than 25 per cent.—that is to say, the lowest resistance of any circuit in a group must not be less than the resistance of the highest in the group, minus 25 per cent. For example: if the highest resistance in a group were 2,000 ohms, then no circuit in the group must have a less resistance than 1,500 ohms, for 2,000 minus 25 per cent. equals 1,500.

When it is found impossible to select a number of circuits to form a group without infringing the foregoing rule, then certain of the circuits will require to be brought or levelled up to the required standard by the introduction of artificial resistances in the *battery leads* of the short lengths. In estimating the values of these resistances 25 per cent. less than the resistance of the longest line is taken as the standard. Thus, if we had five circuits of the respective resistances, 2,000, 1,500, 1,000, 800, 600, then resistance-coils would be added in the battery leads of the three latter circuits of the respective resistances, 500, 700, and 900, for

$$1{,}000 + 500 = 1{,}500.$$
$$800 + 700 = 1{,}500.$$
$$600 + 900 = 1{,}500.$$

It is not considered advisable to balance all the circuits up to a level with the highest standard, since the longer circuits are more affected by leakage than the shorter ones, and their resistances consequently decrease more in wet weather.

The Universal battery consists of either "UK," or "Bichromate" cells. The number of UK cells employed for single current circuits being equal to the number of "Daniell" cells (whether UK, chamber, or ordinary) formerly required to work the circuit of the highest resistance in the group. For *terminal* instruments worked with double currents, as, for instance, the single needle or the double current Morse, *double* the number of cells referred to are required, for, as will be seen, each current has to be sent from an independent battery. If the instruments are intermediate, a greater number of cells may be required, as will be seen hereafter.

If bichromate batteries are used, the number of cells required is only half that of the Daniell cells, as the Bichromate has double the electro-motive force of the Daniell battery.

It was pointed out that the joint resistance of all the lines (after they are levelled up by resistances) grouped on a Universal battery must not be less than the resistance of the battery, hence when a number of circuits are converted to a universal battery system, the following simple rule will determine what kind of battery is best (either bichromate or Daniell) for working the group:—

Divide the resistance of the circuit which has the greatest resistance in the group by the number of circuits, then the resistance of the battery to work the group must always be less than the result of

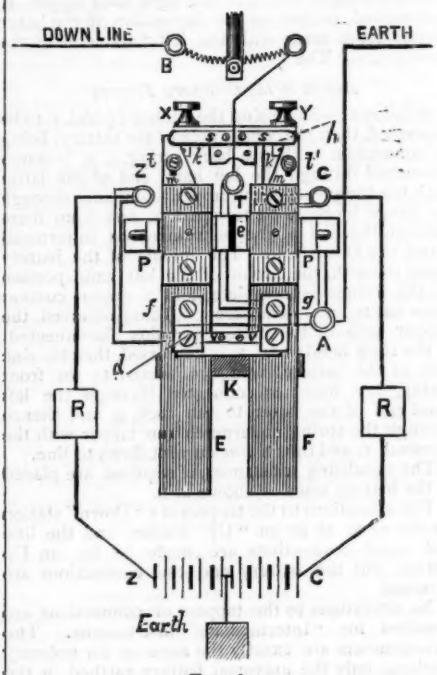


FIG. 80.

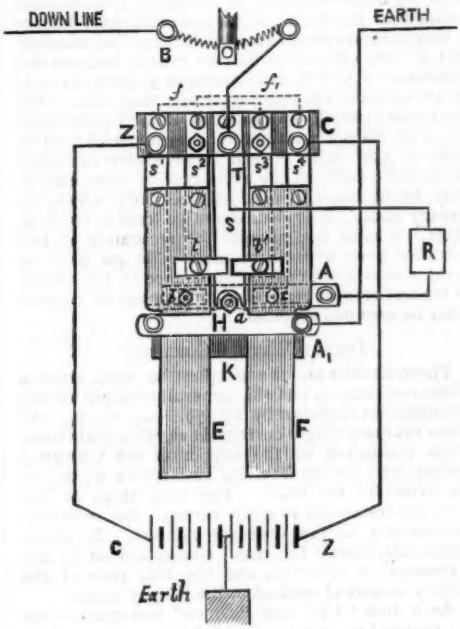


FIG. 82.

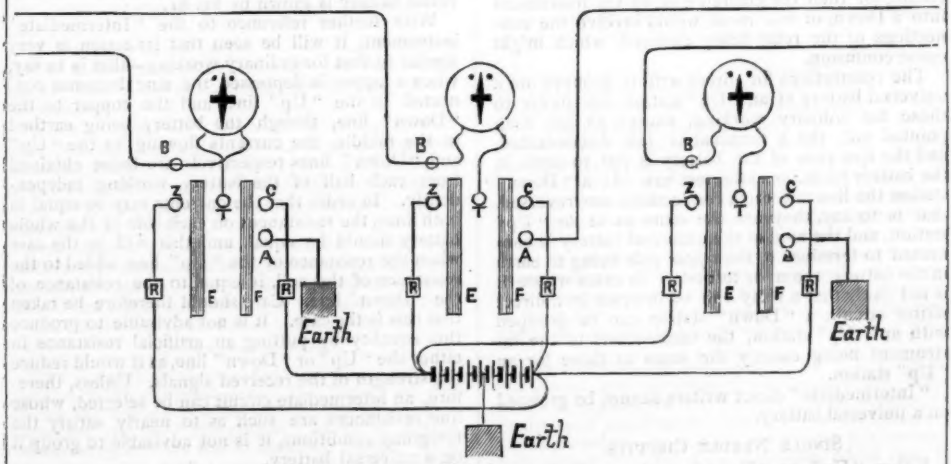


FIG. 81.

such division. Thus, if there are five circuits, the highest of which has a resistance of 1,400 ohms, the resistance of the battery employed should be less than 280 ohms, which result is arrived at by dividing 1,400 by five. If, then, 50 Ordinary Daniell cells sufficed for the circuit of highest resistance before it was grouped on a universal battery that number of UK cells will suffice for the group, because the resistance of 50 UK cells averages 5 ohms per cell, or 250 ohms in all, and this is less than 280. On the other hand, if 70 Ordinary Daniell cells were required, then, since the total resistance of 70 UK cells is 350 ohms, it will be necessary to adopt bichromate cells, as the resistance of these cells is only about one-half that of UK cells, whilst, as already stated, their electro-motive force is twice as great. If with five circuits the resistance of the batteries, even when bichromate cells are used, is greater than a fifth of the resistance of the circuit of highest resistance, a smaller number of circuits must be grouped together.

DIRECT WRITER CIRCUITS.

These circuits are the simplest to work from a Universal battery, and the general principle of the arrangement is shown by fig. 79. K_1, K_2, K_3, are three ordinary single current keys, with their front stops connected to the copper of the Universal battery, two having levelling resistances, R_1, R_2, in the circuit of the leads. The back stops of the keys are connected to earth through the receiving instruments in the ordinary manner. In direct writer instruments the usual connection on to the z terminal is removed, and the zinc pole of the battery is instead earthed in the battery room.

As a rule "Up" and "Down" instruments are not grouped together, but each kind are formed into a separate group, and worked from a separate universal battery. This is done in order to meet the case where a relay may be inserted in a direct writer circuit, for then the changing of an Up instrument into a Down, or *vice versâ*, would involve the connections of the relay being changed, which might cause confusion.

The connections for direct writers grouped on a universal battery at an "Up" station are similar to those for ordinary working, except, as has been pointed out, the z terminal is left disconnected, and the zinc pole of the battery is put to earth in the battery room, or at the test box. At a "Down" station the line and earth connections are reversed, that is to say, they are the same as at an "Up" station, and the zinc of the universal battery is connected to terminal C, the *copper* pole being to earth in the battery room or test box. In cases where it is not likely that a relay will be inserted in a direct writer circuit, a "Down" station can be grouped with an "Up" station, the connections to the instrument being exactly the same as those for an "Up" station.

"Intermediate" direct writers cannot be grouped on a universal battery.

SINGLE NEEDLE CIRCUITS.

Either "Up" or "Down" single needle instruments can be grouped on one universal battery. The connections for an "Up" instrument with ordinary tappers are shown by fig. 80. Each tapper has the left hand end, *h*, of the back spring, *s*, *s*, bent up, so that the tongue, t_1, of the tapper, F, cannot make contact with it when the latter is depressed. Also the front screw, *d*, of the right hand tapper, E, is removed, so that on the depression of the latter no contact is made with the left hand end of the spring, *v*, *v*. The

Action of the Ordinary Tappers

is as follows:—Supposing the left hand pedal, E, to be depressed, then the copper pole of the battery, being in connection with the back spring, *s*, *s*, becomes connected through the left hand end of the latter with the tongue, *t*, of the tapper, and thence through the hinge block with terminal, T, and from there through the dial of the instrument on to terminal B and the Down line. The middle of the battery being to earth, the circuit of the left hand portion of the former is complete, and a *copper* current flows out to line. The screw, *d*, being removed, the copper pole of the battery remains disconnected. If the right hand pedal, F, is depressed, then the zinc pole of the battery, being connected to the front spring, *v*, *v*, becomes connected through the left hand end of the latter to the cock, *g*, and thence through the spring underneath the tapper with the terminal, T, and thus a *zinc* current flows to line.

The equalising resistances, if required, are placed in the battery leads as shown at R.

The alterations to the tappers at a "Down" station are the same as at an "Up" station, and the line and earth connections are made as for an Up station, but the battery and coil connections are reversed.

No alterations to the tappers or connections are required for "Intermediate" instruments. The arrangements are exactly the same as for ordinary working, only the universal battery earthed in the middle is used instead of the ordinary battery.

The general arrangement of an "Up," "Down," and "Intermediate" instrument grouped on a universal battery is shown by fig. 81.

With further reference to the "Intermediate" instrument, it will be seen that its action is very similar to that for ordinary working—that is to say, when a tapper is depressed the zinc becomes connected to the "Up" line, and the copper to the "Down" line, though the battery being earthed in the middle, the currents flowing to the "Up" and "Down" lines respectively are those obtained from each half of the battery working independently. In order that the currents may be equal in both lines, the resistances on each side of the whole battery should be equal, and this will be the case when the resistance of the "Up" line, added to the resistance of the coil, is equal to the resistance of the "Down" line. Care should therefore be taken that this is the case. It is not advisable to produce this equality by putting an artificial resistance in either the "Up" or "Down" line, as it would reduce the strength of the received signals. Unless, therefore, an intermediate circuit can be selected, whose line resistances are such as to nearly satisfy the foregoing conditions, it is not advisable to group it on a universal battery.

The number of cells required for Intermediate instruments is the same as that which was required previous to the conversion to the universal system, since each half of the battery works only half of the entire line at a time. This fact must be taken into

account in calculating the amount of the balancing resistances to be inserted in the battery leads. Thus, for example, if a terminal single-needle instrument be worked on a line of 1,000 ohms resistance, this being the highest resistance of the group, then if an intermediate instrument be worked with the same group, and the resistance of the "Down" line be 700 ohms, and of the "Up" line and coil also 700 ohms, the levelling resistances in the battery leads of the Intermediate instrument would have to be 50 ohms; for $700 + 50 = 750$, which is 25 per cent. less than 1,000 ohms, the resistance of the longest line.

The line resistances referred to of course include the instruments in circuit beyond the station at which the universal battery is placed.

The arrangement of the connections, &c., for the "Bell" form of tapper, when the latter is used for universal working, is shown by fig. 82. For this purpose the straps, f, f_1, connecting s_1 with s_2, and s_3 with s_4, are cut, and the wire joining A with A_1 is removed. If the line requires to be levelled this is done by a single resistance, R, connected between T and A; if no levelling resistance is required, terminals T and A must be connected by a piece of wire.

The connections shown are those for an "Up" instrument, and it should be noticed that the copper of the battery is connected to Z, and zinc to C.

Action of the Bell Tappers.

Supposing the left hand tapper to be depressed, then the tongue, *t*, presses away the spring, S, from the screw, *a*, connected to the bridge piece, H, and thus disconnects the line from earth. When the tapper is quite depressed, then the copper pole of the battery is connected through the medium of the spring s_1, and the screw, *b*, at the end of it, with the brass strip to which terminal A is connected. The current then flows through the resistance, R, to terminal, T, and through the coils to the "Down" line, since the circuit of the left hand half of the battery is complete.

If the right hand tapper is depressed, then a similar action takes place, only the zinc pole of the battery now becomes connected to line through the resistance R.

When a signal is "received," then the current after passing from B through the coils, passes from terminal, T, along the spring, T, to the contact screw, *a*, and from thence through the bridge, H, to earth.

At a "Down" station the battery and coil connections must be reversed.

Bell tappers cannot be worked on a universal battery at "Intermediate" stations, as the action of the tappers would be to send a current out to both lines at the moment when *t* or t_1 touched the spring, S, and before the latter broke contact from *a*.

THE SOCIETY OF ARTS.—Amongst the papers and lectures to be delivered before the Society of Arts during the coming session will be the following:—December 1st, the "Photophone," by W. H. Preece. December 15th, "The Use of Sound for Signals," by E. Price Edwards. After Christmas the following will be amongst the papers and lectures:—"Flashing Signals for Lighthouses," by Sir William Thomson, F.R.S. Four lectures on "The Scientific Principles involved in the Electric Light," by Professor W. G. Adams, F.R.S.

Notes.

THE SOCIETY OF TELEGRAPH ENGINEERS.—The first meeting of the autumn session of this Society was held at the Society's rooms, 4, Broad Sanctuary, Westminster, on Wednesday, November 10th, when a reception was given by the President (Mr. W. H. Preece) on the occasion of the opening of the Ronald's library. A large number of visitors were present. Amongst the exhibits was the American Rapid Telegraph system, which was exhibited in operation. The Ronald's Telegraph, constructed in 1814, was also shown. Mr. Latimer Clark exhibited a number of rare and curious works on electricity dating back as far as the year 1473. The paper to be read before the Society on the 24th inst. will probably be on the "Photophone," by either Mr. W. H. Preece or Professor Graham Bell.

THE ROYAL INSTITUTION.—The lecture arrangements (yet incomplete) for the ensuing season (before Easter) will include the Christmas course by Professor Dewar, and courses by Professors Tyndall and Schafer, the Rev. William Haughton, the Rev. H. R. Haweis, Mr. H. H. Statham, Mr. Reginald S. Poole, and others. Friday evening discourses will probably be given by Mr. Warren De la Rue, Professor Tyndall, Sir John Lubbock, Sir William Thomson, Dr. J. Burdon-Sanderson, Dr. Andrew Wilson, Dr. Arthur Schuster, Mr. Alexander Buchan, Dr. W. H. Stone, and Dr. W. J. Russell.

PHYSICAL SOCIETY, 1880-81.—The meetings of the Physical Society will be held in the Physical Laboratory, Science Schools, South Kensington, on the following days (second and fourth Saturdays in the month), at three o'clock:—November 13th and 27th; December 11th; January 22nd.

LECTURES ON ELECTRICITY.—Lord Raleigh will, during this term, lecture on Galvanic Electricity and Electro-Magnetism, in the Cavendish Laboratory, Cambridge, and Mr. Glazebrook will give an elementary course in electricity and magnetism.

A TELEPHONIC service meter has been invented by Mr. H. L. Bailey, of New York, which enables a telephonic exchange to keep a record of the length of time each subscriber uses his telephone; it also records the number of times each subscriber uses the line. As this has been one of the principal obstacles in the way of the adoption of a combined rental and toll system, instead of the uniform rental system at present in use, we may soon look, if the meter realises the expectations of its inventor, for a change in this respect. In Boston the rental of telephones has been reduced, and a small charge made for each time the line is used. Although the change caused some complaint at first on the part of those who did not understand what it was, the new system is said to give general satisfaction.

A PATENT has just been issued to Mr. J. E. Fenn, of the electrician's department, American Union Telegraph Company, for an important improvement in duplex and quadruplex working. As the Western Union owned the condenser patent, which is a particularly strong one, the American Union found that to enable it to work its long duplex and quadruplex lines it must have a substitute. So Mr. Fenn set about inventing one, and has just secured a patent for the same, as unassailable as is that of the Western Union.

The new device has been in use on the American Union lines for several months, and works to perfection even on quadruplex lines of four hundred miles in length. The American Union is to be congratulated as much on this achievement as on its many other remarkable victories during the past year.—*Operator.*

PROFESSOR A. GRAHAM BELL, in speaking of the future of the photophone, recently said: "It is too soon to speak yet, but I look for its future in a practical use among navigators. For communication of ships at sea, for communication between a lighthouse and a ship, or between a ship that is being wrecked and the people on shore, I also look for it as a means of transmitting messages in times of war, when telegraph lines are down and the country is desolated, and where other electric forms would fail."

GREAT NORTHERN TELEGRAPH COMPANY.—This company proposes to lay down a new cable between Great Britain and the North of Europe. An issue of bonds to the amount of £100,000 is to be made by the company for the attainment of this object.

TELEPHONY IN GERMANY.—The German Post Office authorities are said to contemplate the establishment of a network of telephonic communication for Hamburg and its neighbourhood similar to that recently instituted in Berlin. The tariff will be 200 marks a year for communication of two kilometres in lengths, and 50 marks for every further kilometre.

THE electric conductivity of gas-carbon and its variability under pressure has been re-examined by MM. Naccari and Pagliani. Carbon prisms were carefully covered at certain points of their surface with copper by electro-deposition to secure good contact with the wires by which they were inserted in a Wheatstone's bridge to determine their resistance. When subjected to great pressures the resistances of the rods of carbon showed scarcely any change. Hence it appears that the changes of conductivity which carbon exhibits in the microphone and in the carbon telephone under varying pressures are due not to any alteration of the contact between the particles in the intimate structure of the substance, but to mere changes in the external contact.

DR. WERNER SIEMENS has lately described to the Berlin Academy a new series of experiments on the electric conductivity of carbon, and the way it is affected by temperature. He finds that of gas retort carbon at 0° C. 0·0136 (mercury = 1), and the coefficient of increase of conductivity 0·000345 per degree Celsius. The artificial carbon rods produced by compression of carbon powder also show greater conducting power with increasing temperature, but the increase is not so great (as in retort carbon). Dr. Siemens thinks other experimenters may have been led to erroneous results by faulty connections. He effected the union of the carbon ends with the conducting wires by means of galvanic coppering. The property of conducting better at higher temperatures is regarded as a property of the carbon material itself, not as a consequence of its structure. It may be explained (Dr. Siemens says) as in the case of crystalline selenium, if we assume that the carbon is an allotropic modification (containing latent heat) of a hypothetical metallic carbon.—*Nature.*

ONE of the most brilliant displays of aurora borealis ever seen was witnessed in the Orkney Islands on November 3rd. While the Northern horizon was one dense, dark mass of cloud, with sharply defined edge, the aurora shot up in beautiful coloured streams to nearly the zenith, covering the sky from north-east round to the north-west. Occasionally the aurora took the form of a gigantic rainbow, and the light was as bright as moonlight.

THE ELECTRIC LIGHT ON THE DISTRICT RAILWAY.—The lighting of the Charing-cross Station of the District Railway by the electric light for the first time took place on the 3rd instant. Some time ago an experiment was made by the District Railway Company in lighting their station at Victoria by the Jablochkoff candle. This experiment having proved entirely successful during a period of six months, the directors of the railway have made arrangements with the French Société Générale d'Electricité, by which the new illuminating medium will be permanently employed at three of the most important stations upon their line, that is to say, at Charing-cross, Victoria, and Earl's-court. Much interest was shown in the trial, and a number of gentlemen of scientific or official distinction were present upon the platform; among them Lord S. A. Cecil, M. Jules Gaudet, manager of the Société Générale d'Electricité, Admiral Sir W. Hewett, Sir W. R. Robinson, and Dr. Dugald Campbell, the three last named being directors of the new Electric and Magnetic Company, who take over the patent rights in M. Jablochkoff's invention for England and its dependencies. The interior of the station is lighted by the agency of several lamps with opaque glasses, four upon the down platform, and three on the opposite side. An automatic contrivance only recently introduced insures the lights against the possibility of sudden extinction. Should one of the candles by any chance go out, immediately another takes its place, igniting instantaneously. Each lamp is provided with six of these candles, and by this means is made to burn for twelve consecutive hours without replenishing. The motive power is furnished by a 20 horse-power engine, which has hitherto served to supply the electric current to the lamps upon the Thames Embankment, and which now provides in this way for no fewer than 65 lamps, of which 10 altogether are in use at the Charing-cross Station. With regard to the question of the cost of the light as compared with its rival, gas, the Electric Company state that it shows a saving of about 25 per cent., each electric lamp, equal to 1,000 standard candles, costing 2½d. per hour.

THE directors of the North British Railway have determined to adopt Crompton's system of electric lighting in their Queen Street Station, Glasgow.

NEW RECORDING GALVANOMETER OF G. M. HOPKINS.—In making galvanometric tests it is often desirable to consider the element of time, but, as every electrician knows, to do this with the ordinary appliances is tiresome, and the result is liable to be inaccurate. The extreme delicacy of the action of the galvanometer renders it difficult to apply to it any device capable of recording the movements of the needle without interfering more or less with its action. Only two methods of making the record have presented themselves to the inventor—one contemplates the use of photography, the other the application of a disruptive spark from an induction coil. The former is considered too slow; the latter has been adopted and applied to an ordinary vertical galvanometer. The helices are wound with rather coarse wire (No. 22). The needle is astatic, the inner member swinging in the central opening in the helices in the usual way, the outer member being located behind the helices. The arbor supporting the needle has very delicate pivots, and carries a long aluminum index, which is counterpoised so that it assumes a vertical position when no current passes

through the helices, and the needle is unaffected by terrestrial magnetism. The upper end of the index swings in front of the graduated scale, and is prolonged so as to reach to the middle of a cylinder carrying a sheet of paper upon which the movements of the needle are to be recorded. This cylinder is of brass, and its journals are supported by metal columns projecting from the base upon which the other parts of the instrument are mounted. The scale is supported by vulcanite studs projecting from the columns, and to one of the columns is attached a clock movement provided with three sets of spur wheels, by either of which it may be connected with the arbor of the cylinder. One pair of wheels connects the minute hand arbor of the clock with the cylinder, revolving the cylinder once an hour; another pair of wheels connect the hour hand mechanism with the cylinder, so that the latter is revolved once in twelve hours; while a third pair of wheels gives the cylinder one revolution in six days. This instrument is designed especially for making prolonged tests of different batteries in order to determine their characteristics. It is provided with four binding posts, two of which connect the wires of the batteries under test with the helices. The other binding posts are connected respectively with the posts supporting the needle and with the journals of the recording cylinder. These posts receive wires from an induction coil capable of yielding a spark from one-eighth to one-quarter inch long. The induction coil is kept continuously in action by two Bunsen elements, and a stream of sparks constantly pass between the elongated end of the index and the brass cylinder, perforating the intervening paper, and making a permanent record of the movement of the needle. To render the line of perforations as thin as possible, the end of the index is made sharp and bent inward toward the cylinder. The spur wheels are placed loosely on the arbor of the cylinder, and the boss of each is provided with a set screw by means of which it may be fixed to the arbor. This arrangement admits of giving to the cylinder either of the speeds, as may be required. The paper upon which the record is to be made is divided in one direction into degrees and in the other into hours and minutes. The hour and minute lines are curved to coincide with the path of the end of the index. The greatest strength of current being indicated by the greatest deflection from the central line of the record sheet, the approach of the index toward the central line indicates a diminution of the current, which is faithfully recorded by the passing sparks. These records may be duplicated by using the sheet as a stencil and employing the method of printing used in connection with perforating pens. When the tests are of long duration the action of the induction coil is rendered intermittent by an automatic switch connected with the clock. This method of recording may be applied to the electrical dynamometer, to electric meters, and to the more delicate galvanometers; and substantially the same device may be applied to recording thermometers, barometers, and other delicate meteorological instruments.—*Scientific American.*

APROPOS of Professor Graham Bell's experiments, C. Cros, in *Comptes Rendus*, says that since light in passing from one medium to another of different density (separated from each other by a surface oblique to the direction of the rays) undergoes a deflection, we may infer that if the medium acts upon it, it must in turn act upon the medium. The author, therefore, affirms that light tends to assimilate the density of the medium which it traverses to that of the medium whence it has issued. It tends to displace the transparent body in an opposite direction to the deviation which it undergoes. In case of reflection the reflecting body undergoes repulsion.—*Chemical News.*

THE *Popular Science Monthly* for November contains papers on "The Electric Burglar Alarm," "Henry and Faraday," by Professor A. M. Mayer, and "Education as a Hindrance to Manual Occupations," by Professor Sylvanus P. Thompson.

AT the evening concerts being organised at the gardens of the Palais Royal, the orchestra is to be placed near some fountains illuminated by eight magnificent lamps of Siemens. Two other Siemens' lamps have been placed under the galleries in the Magasin d'un Joaillier. It is probable that after this experiment the whole palace will be lighted by electric light.

THE Commissioners of Sewers were to have been asked on Tuesday last to adopt the tenders of the Anglo-American Company (Brush), of the Electric and Magnetic Company (Jablochkoff), and of Messrs. Siemens Brothers, for lighting by electricity three large districts of the City of London, at a cost for twelve months of £5,060. The matter was, however, adjourned.

PRODUCTION OF ALCOHOL BY AN ELECTRIC CURRENT.—Berthelot's experiment was recently conducted in the following manner:—A battery of eight Bunsen elements was connected with an oscillating commutator, so that from twelve to fifteen currents were sent in alternate directions per second, which were conducted to two electrodes of spongy platinum. The platinum cylinder was placed in acidulated water, and the contact action so arranged that neither oxygen nor hydrogen were given off, but the decomposed water regenerated as rapidly as it had been split up. When all had thus been arranged, the two electrodes of the apparatus were immersed in a watery solution of glucose. In this way alcohol was obtained, although, it is true, in but small quantity. It is hoped, however, by modifying the apparatus that the process may be improved and even made of technical importance.—*Chem. Central Blatt*, 1880, 288.

WE notice that an order has been made for compulsorily winding-up the "Navigating Telegraph Company (Limited)," mentioned in our issue of March 1st of this year as having been incorporated.

TELEPHONIC communication has been established between Manchester and Liverpool, a distance of about thirty miles. Congratulatory messages passed between Alderman Thomas Baker and Alderman W. B. Forwood, Mayors of Manchester and Liverpool respectively. Bell telephones with Blake transmitters are used.

New Patents—1880.

4341. "An improved electrical apparatus for operating bells, signals, and telegraphs." G. SKRIVANOFF. Dated October 25.

4391. "Improvements in means for measuring the amount of electrical current flowing through a circuit, which is denominated a webermeter." P. JENSEN. (Communicated by T. A. Edison.) Dated October 27.

4393. "Electric lighting apparatus." W. R. LAKE. (Communicated by H. S. Maxim.) Dated October 27.

4428. "Electric lamps." J. H. JOHNSON. (Communicated by A. Berjot.) Dated October 29.

4434. "Telegraphic recording apparatus." T. M. FOOTE. Dated October 30.

4441. "Improvements in alarms and indicating apparatus for boilers, cisterns, tanks, ventilators, and the like." F. KING AND G. GREEN. Dated October 30.

4444. "Electric gas-lighting apparatus." H. H. LAKE. (Communicated by F. W. Pelton.) Dated October 30.

4482. "Cables for telephonic purposes." E. GEORGE AND J. B. MORGAN. Dated November 3.

4495. "Electric-lighting apparatus." W. R. LAKE. (Communicated by J. V. NICHOLS.) Dated November 3.

4515. "Imparting electric currents to fluids whilst passing into the mouth." J. DUNBAR AND R. R. HARPER. Dated November 4.

4564. "Improved thermometers and barometers with electric scale." E. EDMONDS. (Communicated by O. Koch and A. Eichhorn. Dated November 6.

4581. "Telegraph receiving apparatus." J. W. FULLER. Dated November 8.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

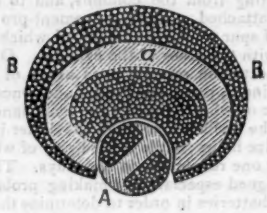
905. "Covering wire with insulating material," &c. J. C. L. LOEFFLER. March 1. 2d. Relates to the covering of wire with insulating material, such as gutta-percha or other plastic substance, in such a manner as to obtain two or more layers of covering on the wire at one operation. A die is formed with central holes of successively larger diameter through which the wire is caused to travel. To the space between each pair of these holes is provided lateral passages for the plaster material, so that as the wire travels along it receives first one layer of covering, and after passing through the first hole it receives a second, and so on. (Void by reason of the patentee having neglected to file a specification in pursuance of the conditions of the Letters Patent.)

1212. "Electrical fire alarms." C. E. SPAGNOLETTI. Dated March 20. 6d. (*See* page 381.)

1234. "Galvanic batteries." A. M. CLARK. (A communication from N. E. Reynier, of Paris.) Dated March 22. 1s. Relates to batteries similar to those described in *Telegraphic Journal*, page 271, vol. viii.

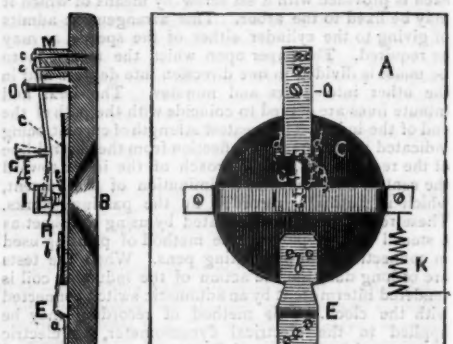
1244. "Regulating electro-magnetic motors, and apparatus employed therein." JOHN HENRY JOHNSON. (A communication from W.W. Griscom, of Philadelphia, U.S.) Dated March 23. 6d. The plates of the battery driving the motor are connected to a treadle, by the depression of which the plates can be lowered to a greater or less depth in the exciting solution, and thus the strength of the current and consequent speed of the motor be regulated. The plates are drawn upwards by means of a spring.

1259. "Electro-magnetic motors and dynamo-electric machines." JOHN HENRY JOHNSON. (A communication from W. W. Griscom, of Philadelphia, U.S.) Dated March 24. 6d. Relates chiefly to the construction of the electro-magnetic of the motor or dynamo-machine, by which the free magnetism distributed over the magnet is utilised, as well as that concentrated at the poles. The core, *a*, of the magnet, B, as illustrated in the figure, is made of a form which may be said to represent a tube, the continuity of which is interrupted by a longitudinal slot extending from end to end of the tube, and in this slot a rotating armature, A, is so arranged that while the poles of the magnet are on opposite sides of the armature, in line with its axis, the entire body of the magnet with its poles shall closely envelop or surround a portion of the rotary armature in the direction of rotation, as shown in the drawing, the object being to so construct the magnet that all its parts will be as near as practicable to the armature, so



that all parts of the magnet will exert their maximum effect, and the helices are arranged in such a manner as to exert their full force upon one another.

1286. "Telephones." J. H. JOHNSON. (A communication from C. Marx, F. Aklemm, and J. Kayser, of New York, U.S.) Dated March 27. 6d. Relates to an improved telephone transmitter which is not affected by variations of temperature or other disturbing causes. A is the front of an ordinary transmitter box, and B the bevelled opening or mouthpiece leading to the diaphragm, C; the latter is held in contact with a felt or other suitable damping ring or shoulder, D, by



means of a metallic spring arm, E, which is secured at one end by screws, *a*, *a*, to the front piece, A, and by screws, *b*, *b*, at the other end to the diaphragm, so that the arm, E, is practically a spring hinge. On the opposite side to this spring hinge is secured to the piece, A, a practically rigid metallic arm, F, which is fastened in place by screws, *c*, *c*. The free end of this arm is bifurcated or mortised, and in the mortised portion is pivotted by adjustable screw pivots, *d*, *d*, a knee or metal angle piece, G, to the lower extremity of the vertical leg of which is secured in any suitable manner

a carbon button, H, which is kept in contact with the platinum point, *e*, in the centre of the diaphragm by the gravity of the horizontal leg of the knee. I is a metal bridge secured to the piece, A, at right angles preferably to the arm, F, and this bridge and the knee, G, are electrically connected by a conducting wire, *f*, the other necessary connections being made by wires, K, L, from the one end of the bridge, I, and the end of the spring hinge, E, respectively. The arm, F, is secured to the piece, A, by a post or block, M, and screws, *c*, *c*, and with its lower end inclined towards the diaphragm; O is a screw which has a thread bearing in the arm, F, and its end in contact with the piece, A, or a bearing block secured thereto, so that the inclination of the said arm may be slightly adjusted or varied by the act of turning the said screw. The necessary connections to the induction coils, &c., are made in the ordinary manner.

1295. "Insulating electrical conductors." E. M. ALLEN. (A communication from A. A. Knudson and F. L. Kane, of Brooklyn, U.S.) Dated March 30. 6d. Relates to an insulating coating for enveloping and protecting electrical conductors, more especially such conductors as are designed for telegraphic purposes, and are therefore required in some instances to be suspended in the air, and in other cases to be buried in the earth or submerged in water. The invention consists in applying to the conductors a covering of fibrous material, which is saturated with a compound composed of native bitumen or asphaltum having paraffin oil or residuum of petroleum or candle tar mixed therewith, which not only forms a more efficient, durable, and permanent insulating material than any which has heretofore been employed for similar purposes, but which can be prepared at a much smaller cost.

1328. "Telegraphic and telephonic apparatus." W. R. LAKE. (A communication from E. Davis, of Chicago, and P. A. Dowd, of Boston, U.S.) Dated March 31. 1s. By this invention a certain station (for example, the central office), can call any one of a large number of stations in one circuit, without at the same time sounding the bells or giving other signals at the other stations in the circuit; each station can call the central office without sounding the bells at the other station in the same circuit; each station can communicate with the central office and with any other station; the central office can communicate with any station without the knowledge of the other stations; any of the stations can be connected in order that they may communicate each with the others, and without the knowledge of any station not connected; and the system and apparatus used can be made simple, durable, and not easily deranged. In this invention, one heavy current, one light current, and one heavy current will so move the parts of one of the instruments as to sound the alarm, but will not thus move any other instrument in the series; one heavy, two light, and one heavy will cause another instrument, say, at station two, to signal, but will not cause the instrument at any other station to signal; one heavy, three light, and one heavy will sound the alarm at station three, but no other; one heavy, four light, and one heavy at station four, and no other, and so on, no signal being sounded, except when its own peculiar series of currents pass over the main circuits.

1333. "Machinery for the manufacture of engine-packing and insulated telegraph wires." G. F. JAMES. Dated March 31. 6d. Has for its object both the lapping and braiding or plaiting of any desired number of threads or strands or series of laps or braidings round any desired central core in one and the same machine, and consists in so arranging the lapping spindles and the braiding spindles in the same frame-work, and by preference to revolve round the same axis, that the core, say, after being lapped, is then taken through one or more series of braiding spindles, which braid a corresponding number or coatings of braid upon such lapped material.

1339. "Rotary induction or electric motor." J. C. MEWBURN. (A communication from W. de Fonvielle, of Paris.) Dated April 1, 2d. Consists—1st, of a galvanometric frame of any suitable form, on which are wound a number of turns of one or more insulated electric wires; 2nd, of a motor mounted on a pivot or axis and situated in the centre or at the top or bottom or in proximity to the galvanometric frame, so that the requisite action can be produced. It is formed of a piece of magnetic or magnetisable metal, either solid or hollow, which is put into motion by the action of the current circulating through the spirals of the galvanometric frame; and 3rd, of magnets grouped or arranged in suitable position around the motor. (*Provisional only.*)

1343. "Apparatus for the production and application of electricity and magnetism." LOUIS PULVERMACHER. Dated April 1. 8d. Relates to improvements in the inventor's well-known chain batteries.

1392. "Dynamo-electric machines." W. R. LAKE. (A communication from H. S. Maxim, of Brooklyn, U.S.A.) Dated April 5. 8d. Relates to a device for regulating dynamo-electric machines in respect to the amount of electricity generated, so as to render the electro-motive force of the current constant at each point of consumption (*see* page 382); it also relates to improvements in the construction of the armature and commutator of such machines.

1397. "Electric lamps." C. D. ABEL. (A communication from F. Krizik and L. Piette, of Pilsen, Austria.) Dated April 6. 6d. Relates to a method of effecting automatically the regulation of the distance of the carbons in an electric lamp, without the aid of clock-work, or other like mechanism, by the use of solenoids having special cores, such solenoids and cores being applicable where, as in electric lamps, uniformity of attractive force has to be maintained throughout a considerable length of stroke.

1407. "Electrical conductors for telegraphic and telephonic purposes." OLIVER HEAVISIDE. Dated April 6. 6d. Has for its object the rendering of a circuit completely independent under all circumstances of external inductive influences. For this purpose two insulated conductors are used for the circuit and one is placed inside the other. Thus, one conductor may be a wire and the other a tube or sheath, thus forming a compound conductor consisting of a central wire surrounded by an insulating covering, which is in its turn surrounded by a conducting tube or sheath which must also be insulated.

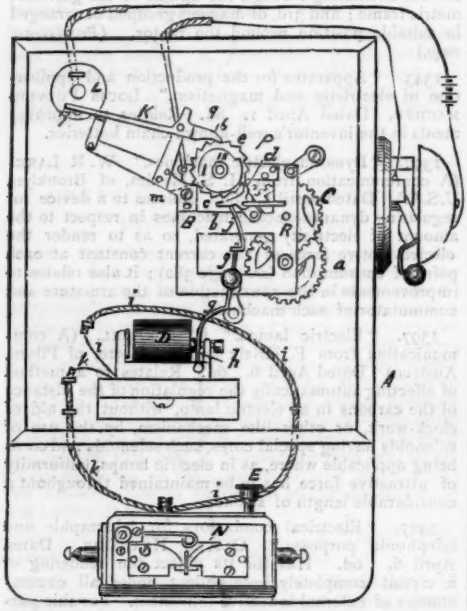
2136. "Signal apparatus for telephonic or telegraphic purposes." W. R. LAKE. 6d. (A communication from abroad by Charles Sumner Eaton, of Lowell, Massachusetts, U.S.A.) Relates to call or signal apparatus for telephonic or telegraphic purposes.

Where a number of telephones are included within a single electrical circuit, as heretofore, and the operator at one station wishes to communicate with another station, he sounds on the electric signal or call-bell of the receiving station the number by which it is designated to call the attention of the attendant at that station. As, however, the signal bells of all the stations are in the same circuit the signal is sounded simultaneously at every station, causing a great annoyance by

reason of the frequent ringing of the bells, and the necessity for the attendant at each station to be constantly on the alert, in order to distinguish the different signals and recognise that of his station, so as to know when it is called.

To avoid this simultaneous ringing of all of the signal bells of the different stations in an electrical circuit, and to cause only the bell at the particular station to which the message is to be sent to be sounded while the others remain silent, is the object of this invention.

The figure is a front elevation of the improved call or signalling apparatus. *c* is a train of clockwork actuated by a spring, *a*, and provided with a "dead beat" escapement. The plate *b* (carrying at its ends the pallets, *c*, *d*, which engage with the teeth of the escapement-



wheel, *e*), is provided with a rod or wire, *f*, which is attached to its under side, and is vibrated by an arm, *g*, projecting up from the armature, *h*, of an electro-magnet, D, the upper end of the arm, *g*, passing through a loop at the lower end of the rod, *f*. The electro-magnet, D, has its coils connected with the main line wire, and can be worked by means of a key, E, at each station.

To the outer end of the arbor, *m*, of the escapement-wheel, *e*, is secured an index-hand or pointer, which moves over a dial, bearing on its face the numbers of the telephone stations in the circuit. Upon the arbor, *m*, is also secured a wheel or disc, I, provided with a notch, *p*, and against the periphery of the disc, I, rests one end, 16, of a nearly balanced lever, K, having its fulcrum at *q*, the opposite end, 17, of this lever being so placed as to come into contact with a metallic stud or post, L, when its end, 16, is allowed to drop to, or nearly to, the bottom of the notch, *p*, in the disc, I, this contact of the end, 17, of the lever, K, with the stud, L, completing a local circuit, in which the call-bell, M, is included, and giving an alarm to notify the attendant that it is desired to communicate with his station.

The notch, *p*, of the disc, I, is so placed with respect to the index-hand and dial that the end, 16, of the lever, K, will drop into it to close the bell-circuit and give the alarm only when the index-hand points to a particular part of the dial corresponding to the number of the station to which the instrument belongs; and to close the bell-circuit when the hand is in the position referred to, the operator at the transmitting station must keep the key, E, depressed a sufficient length of time to give the end, 16, of the lever time to drop to, or nearly to, the bottom of the notch, *p*, so that its opposite end, 17, will strike the stud, L, otherwise the call-bell will not be rung. When, however, the operator removes his finger from the key, E, allowing it to rise, the circuit through the electro-magnet, D, is closed, and the disc, I, is rotated sufficiently to raise the end, 16, of the lever, K, out, or nearly out, of the notch, *p*, and thus open the bell-circuit and stop the ringing of the call-bell, M. When the notch, *p*, of the disc, I, is carried rapidly past the end, 16, of the lever, K, which is effected by releasing the key, E, instantaneously after each depression, the end, 16, will not have time to drop into the notch, *p*, sufficiently far to bring the other end, 17, of the lever into contact with the stud, L, but will be caught by the inclined portion, 18, of the notch, *p*, and again raised up before the end, 17, can come into contact with the stud, and consequently the call-bell, M, will not be sounded. This rapid movement of the notch, *p*, of the disc, I, past the end, 16, of the lever, K, will occur when some other station in the circuit is being called, which will necessitate the revolving of the notch, *p*, past the end, 16, of the lever.

The following are the final quotations of telegraphs for the 11th inst.:—Anglo-American Limited, 61¾-62¼; Ditto, Preferred, 91½-92½; Ditto, Deferred, 32-32½; Black Sea, Limited, ——; Brazilian Submarine, Limited, 9¾-10; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16-16½; Direct Spanish, Limited, 2½-3½; Direct Spanish, 10 per cent. Preference, 12¼-12½; Direct United States Cable, Limited, 1877, 11¾-12; Scrip of Debentures, 101-103; Eastern, Limited, 9⅞-9⅞; Eastern 6 per cent. Preference, 12½-12¾; Eastern, 6 per cent. Debentures, repayable October, 1883, 103-107; Eastern 5 per cent. Debentures, repayable August, 1887, 103-105; Eastern, 5 per cent., repayable Aug., 1899, 105-107; Eastern Extension, Australasian and China, Limited, 9¼-10¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 105-107; Ditto, registered, repayable 1900, 106-108; Ditto, 5 per cent. Debenture, 1890, 101-103; Eastern and South African, Limited, 5 per cent., Mortgage Debentures redeemable 1900, 102-104; Ditto, ditto, to bearer, 102-104; German Union Telegraph and Trust, 9¼-10¼; Globe Telegraph and Trust, Limited, 6¼-6¾; Globe, 6 per cent. Preference, 12-12½; Great Northern, 10¼-10⅝; Indo-European, Limited, 24-25; London Platino-Brazilian, Limited, 4¾-5¼; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10¾-11¼; Reuter's Limited, 11-11½; Submarine, 250-260; Submarine Scrip, 2⅜-2½; West Coast of America, Limited, 3-3¼; West India and Panama, Limited, 1¼-1½; Ditto, 6 per cent. First Preference, 6¼-6¾; Ditto, ditto, Second Preference, 5¾-6¼; Western and Brazilian, Limited, 7⅞-8⅛; Ditto, 6 per cent. Debentures "A," 106-110; Ditto, ditto, ditto, "B," 97-100; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 118-122; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 34¼-35; Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus Trust Certificates, 3⅛-3⅜; India Rubber Company, 17-17½; Ditto 6 per cent. Debenture, 106-108.